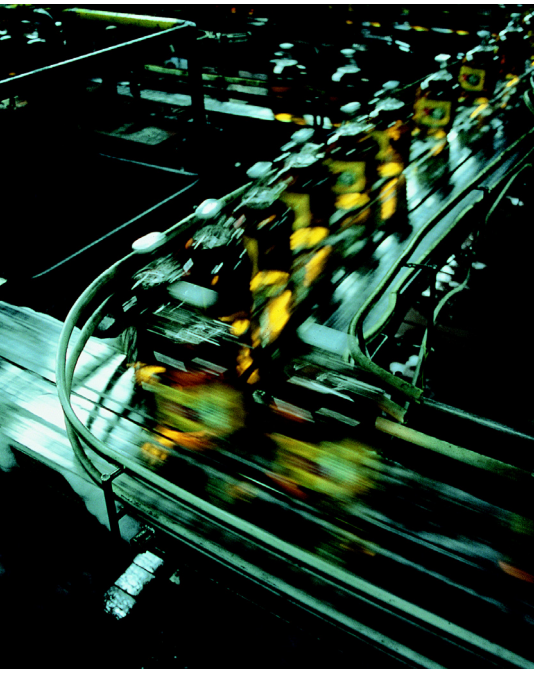

Deploying 802.11 Wireless LAN Technology within a Converged Plantwide Ethernet Architecture White Paper

October 2014

Rockwell Automation and Cisco Four Key Initiatives:

- Common Technology View:
  A single system architecture, using open, industry standard networking technologies, such as Ethernet and IP, is paramount for achieving the flexibility, visibility, and efficiency required in a competitive manufacturing environment.
- Converged Plantwide Ethernet Architectures:
  These manufacturing focused reference architectures, comprised of the Rockwell Automation Integrated Architecture™ and Cisco's Ethernet to the Factory, provide users with the foundation for success to deploy the latest technology by addressing topics relevant to both engineering and IT professionals.
- Joint Product and Solution Collaboration:
  Stratix 5700™ and 8000™ Industrial Ethernet switches incorporating the best of Cisco and the best of Rockwell Automation.
- People and Process Optimization:
  Education and services to facilitate Operational Technology (OT) and IT convergence and allow successful architecture deployment and efficient operations allowing critical resources to focus on increasing innovation and productivity.

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Introduction

Converged Plantwide Ethernet (CPwE) is the underlying architecture that provides standard network services to the applications, devices, and equipment found in modern Industrial Automation and Control System (IACS) applications. The CPwE architecture provides design and implementation guidance to achieve the real-time communication, reliability, and resiliency requirements of the IACS. CPwE Wireless Local Area Network (WLAN) for plant floor machine Wi-Fi communications is brought to market through a joint partnership of Cisco Systems and Rockwell Automation, providing manufacturers the necessary guidance to meet the challenges of a fully integrated IACS.

Two different Wi-Fi architectures are validated in CPwE WLAN, including Autonomous (stand-alone) Access WLAN and Unified (centralized) Access WLAN. With two differing architectures, CPwE WLAN allows users to make an informed architecture selection that meets both business and technical needs. CPwE WLAN provides the tools to realize the industrial networking business benefits.

The benefits of the CPwE Autonomous Access WLAN architecture include:

- Lower initial hardware cost, lesser technical expertise.
- Simplified setup.
- More granular control of Quality of Service (QoS) for critical IACS applications.

The benefits of the CPwE Unified Access WLAN architecture include:

- Reduced operational expenses.
- Dynamic and adaptive RF capabilities.
- Self-healing topology.
- Enhanced security.
- Support for plant-wide mobility.

Today, plant-wide architectures increasingly use Wi-Fi (802.11) networks for critical IACS applications that require reliable data transmission with low levels of latency and jitter. Wi-Fi WLANs differ significantly from traditional wired LANs in their use of shared radio frequencies, susceptibility to interference, and coverage impairments. Deploying a Wi-Fi network requires thoughtful planning and design as well as periodic monitoring to meet expectations for bandwidth, throughput, reliability, and security. CPwE WLAN details a joint architecture for successful Wi-Fi WLAN design and implementation that meet the performance requirements of IACS applications.

Converged Plantwide Ethernet WLAN

The CPwE WLAN system is tailored to IACS equipment use cases for Wi-Fi networking within the Cell/Area Zone in the plant (future releases of CPwE WLAN will address mobile personnel, BYOD, and wireless guest access). Both Unified and Autonomous WLAN architectures have been individually validated, allowing for architectural selection practical to a plant's small or large-scale plant-wide deployment. The abilities of both Unified and Autonomous Wireless LANs are defined to integrate the IACS into the broader manufacturing environment. A wide range of client device types and IACS applications are taken into consideration. By adopting such solution architectures, the manufacturing process will operate at higher levels of performance, efficiency, and uptime.

CPwE WLAN defines:

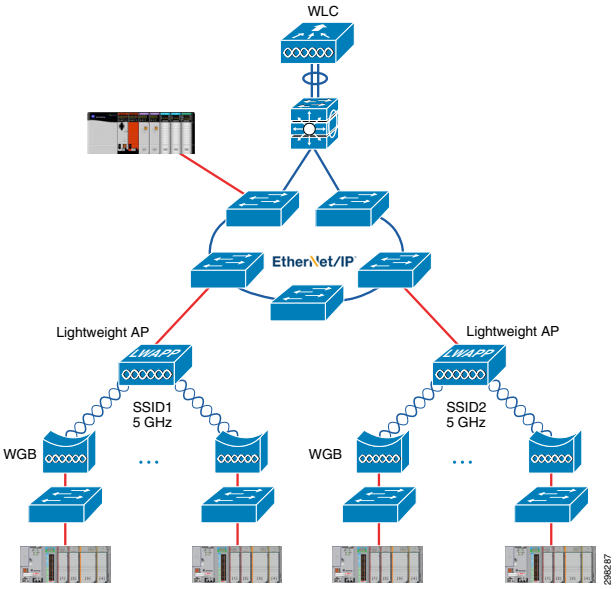
- Important steps and considerations for WLAN implementation with IACS applications.
- IACS application recommendations for Wi-Fi communication.
- Wi-Fi IACS equipment use cases and recommended topologies.
- Radio frequency (RF) design and WLAN configuration recommendations.
- Wi-Fi performance results, and observations.

Unified and Autonomous CPwE WLAN Architectures

Two Wi-Fi architectures are validated within CPwE WLAN: the Unified Access WLAN and the Autonomous Access WLAN.

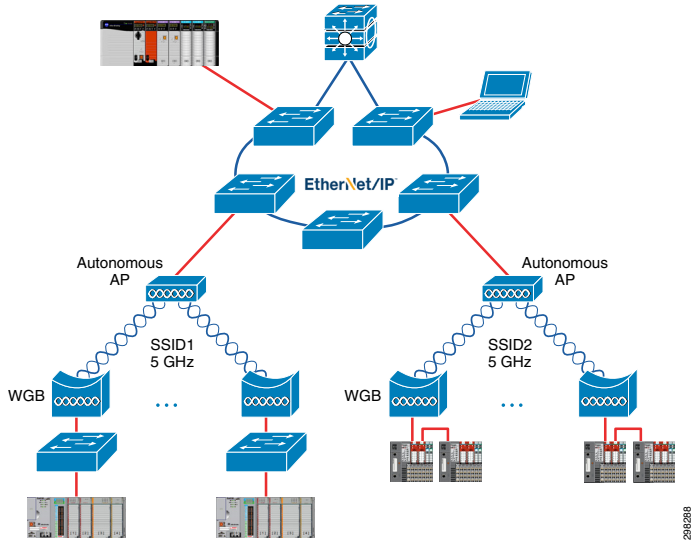
Unified Access WLAN Architecture—As illustrated in Figure 1, this architecture has the ability to address large-scale plant-wide Wi-Fi needs. The Unified Access architecture allows for centralized management and control of the wireless access points distributed through the plant. By utilizing a Wireless LAN Controller, a centralized management model is created, thus introducing security and self-healing mechanisms to the wireless architecture. The Unified Access architecture also introduces foundational services, including intrusion prevention and wireless guest access, for better control over devices seeking to connect to the Wi-Fi network.

Figure 1 Unified WLAN



Autonomous WLAN Architectures—As illustrated in Figure 2, these architectures do not utilize the centralized management structure found in the Unified Access WLAN. Each Access Point (AP) functions as its own standalone device, as an AP or Workgroup Bridge (WGB), without the need for a WLC. The Autonomous WLAN architecture is therefore less costly to implement. Autonomous WLAN APs utilized in the CPwE WLAN architecture may be later re-purposed (not covered in this white paper) to the Unified Access architecture as deployment needs change or as large scale plant-wide growth requires an architectural transition.

Figure 2 Autonomous WLAN



CPwE WLAN Use Cases

Fixed, Nomadic, and Relocation Client Devices CPwE WLAN includes single Coverage Cell/Area Zone uses, including fixed, nomadic, and operational relocation client devices:

- Fixed Position—Fixed position devices in the CPwE WLAN architecture have a permanent operational location, also known as "static." Fixed position wireless is an alternative to a wired connection for hard-to-reach and remote locations where cabling is too expensive or impossible to install. Usage areas include process control, machine condition monitoring, fixed environmental monitoring and energy industries. In the manufacturing environment, a a common use case is a stand-alone OEM machine or skid that needs to be integrated into a production line over a wireless link.
- Nomadic—Nomadic equipment stays in place while operating and then moves to a new location in the shutdown state. After relocation, a new wireless connection commonly needs to be established. Common examples are process skids, storage tanks, reactors, and portable manufacturing equipment.
- Operational Relocation—Mobile equipment changes position during an operation, while remaining in the same Coverage Cell/Area Zone. The examples are rotary platforms and turntables, Automated Storage and Retrieval Systems (ASRS), and assembly systems with tracks, overhead cranes, and similar machinery that use wireless as a replacement for wired solutions such as inductive rails and slip rings. These applications may require rapid changes in position and orientation of the wireless client relative to the AP within the Cell/Area Zone.

IACS WLAN Topologies

- Fixed PAC-to-Wireless I/O Topology—In this topology, a fixed PAC in the wired infrastructure controls a number of I/O devices behind WGBs.
- Fixed PAC-to-Wireless PAC Topology—In this topology, a fixed PAC in the wired infrastructure communicates to a number of PACs behind WGBs.

Summary

Cisco Systems and Rockwell Automation have produced the CPwE WLAN architecture, based upon IEEE 802.11 Wi-Fi industry standards. Even though Wi-Fi wireless local area network needs can differ significantly from customer to customer, CPwE WLAN defines a validated architecture for both Unified Access WLAN architecture and Autonomous Access WLAN customer needs. Design considerations allow for customers to overcome common challenges, including shared radio frequencies, interference, and coverage impairments through technology features such as QoS and Wi-Fi network management features. CPwE WLAN aids customers in deploying a Wi-Fi network through planning and design guidance, allowing for a network architecture optimized for IACS bandwidth, throughput, reliability, and security needs.

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